

# **Safety Study of Artificial Turf Containing Crumb Rubber Infill Made From Recycled Tires: Measurements of Chemicals and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface**

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- California Environmental Protection Agency (Cal/EPA)

Funded by the California Department of Resources Recycling and Recovery (CalRecycle)

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# Cross-section of the new generation of artificial turf playing field containing recycled crumb rubber infill

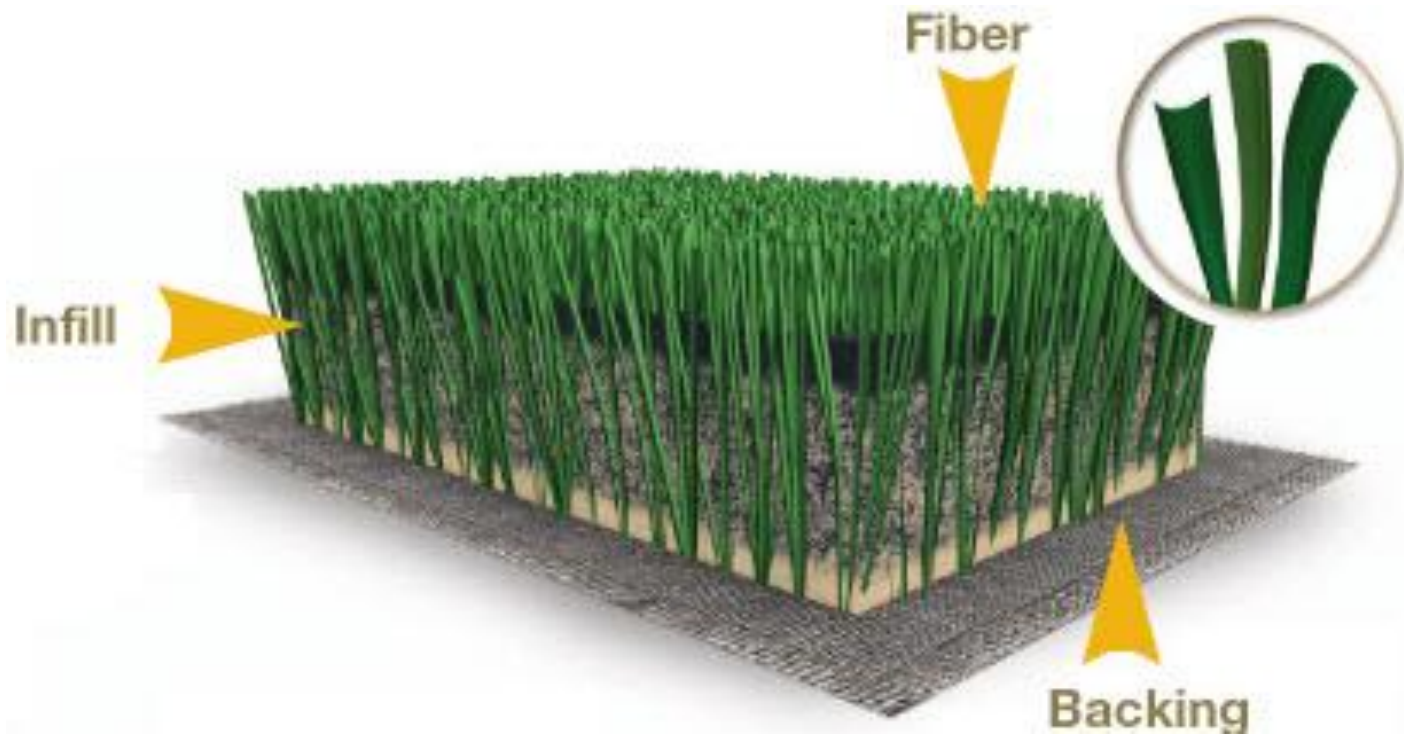
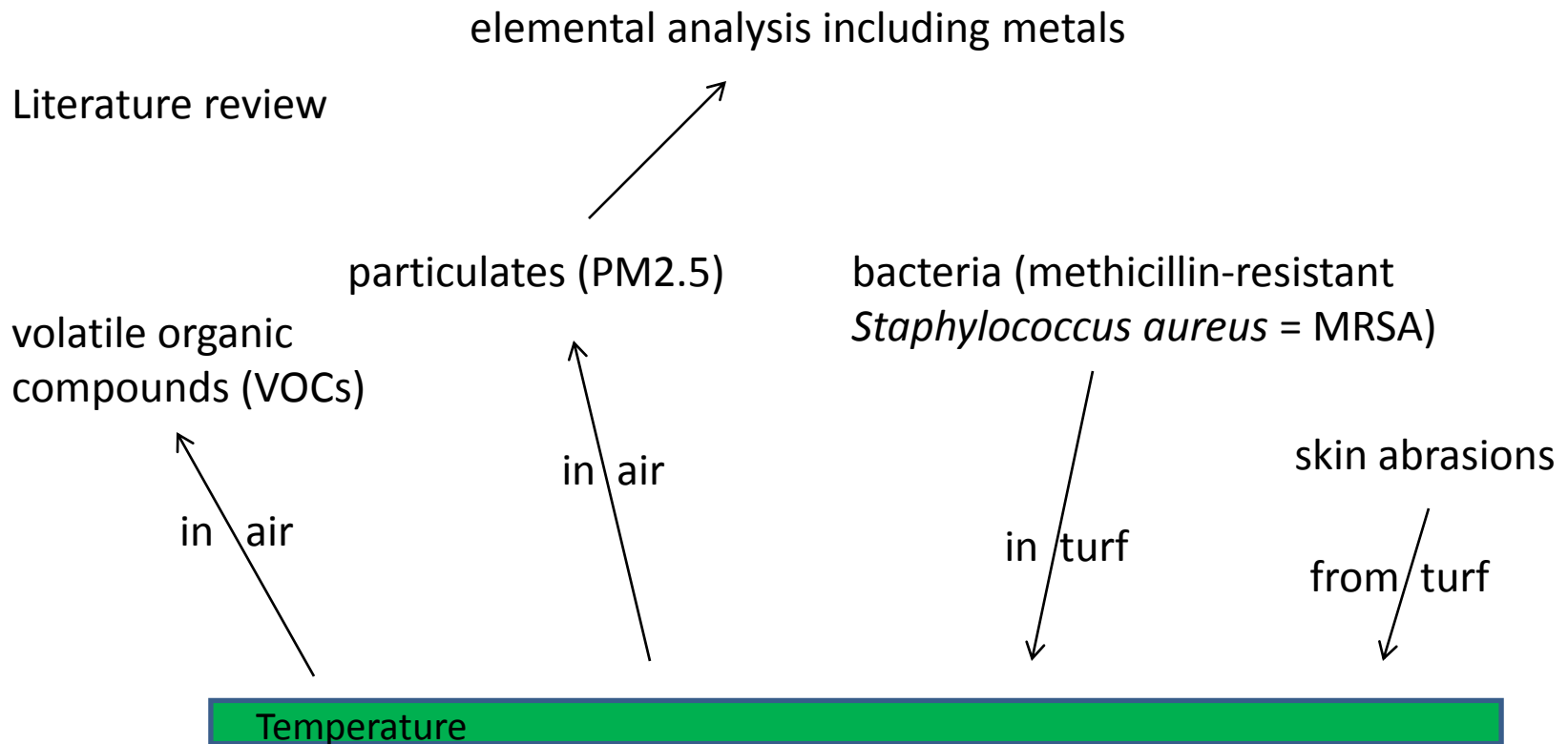
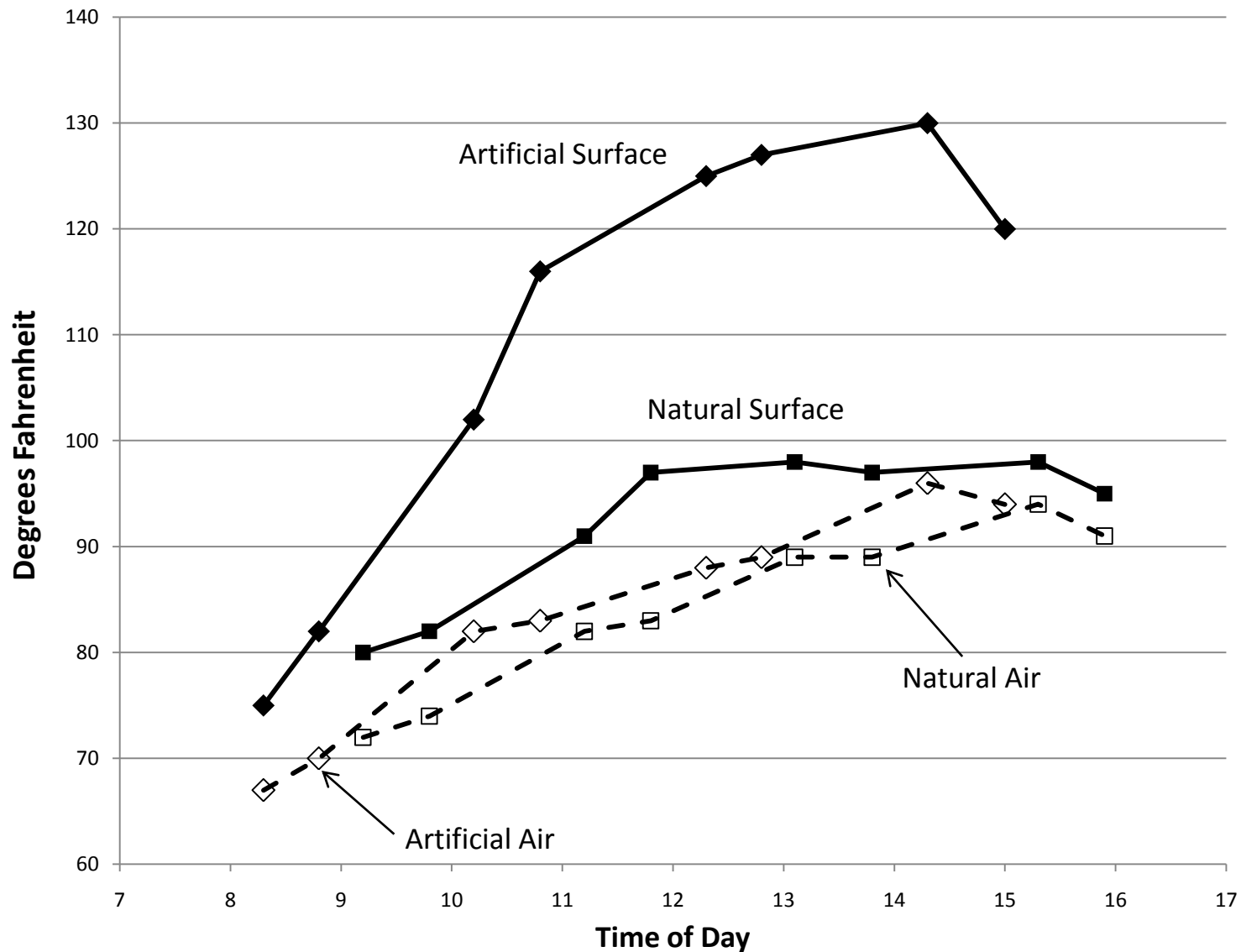


Image taken from FieldTurf web site

# Components of OEHHA artificial turf study



# Measuring VOCs: Surface and Air Temperatures of an Artificial and Natural Turf Field During the Day



VOCs detected in air sampled from above an artificial and natural turf field during the day: example of data collected

[illegible]

# VOCs Above Artificial Turf: Results and Conclusions

- Most VOCs were below detection limits
- Those VOCs detected exhibited little consistency of detection throughout the day or from field to field (four fields were tested)
- There was no correlation between VOCs detected and surface temperature up to 137°F
- All calculated exposures were below health-based screening levels
- No public health concern was identified

# PM2.5 concentrations above three artificial turf fields containing rubber crumb: example of data collected

<b>Artificial turf field</b>	<b>Date sampled</b>	<b>Sample type</b>	<b>PM<sub>2.5</sub> air concentration (µg/m<sup>3</sup>)</b>
#1	4/29/09	Upwind	*
#1	4/29/09	Field	*
#1	4/30/09	Upwind	*
#1	4/30/09	Field	*
#2	5/9/09	Upwind	16
#2	5/9/09	Field	16
#2	5/10/09	Upwind	12
#2	5/10/09	Field	18
#3	6/6/09	Upwind	*
#3	6/6/09	Field	*
#3	6/7/09	Upwind	*
#3	6/7/09	Field	*

\*Below limit of detection (LOD)

# PM2.5 Above Artificial Turf: Results and Conclusions

- PM2.5 was either below the level of detection or at similar concentrations above artificial turf fields and upwind of the fields
- PM2.5-associated heavy metals were below the level of detection: arsenic, cadmium, lead, manganese, mercury, nickel, zinc
- No public health concern was identified



# Three most prominent **bacteria** cultured from artificial or natural turf components: example of data collected

Location on field	Field component	Sample weight (g)	Bacteria in sample (CFU/g)	Bacteria identified
<b>Field #1, artificial turf</b>				
1	Infill <sup>2</sup>	2.2	5,510	<i>Brevibacterium</i> species, <i>Pseudomonas stutzeri</i> , <i>Rhodococcus</i> species
1	Blades <sup>3</sup>	0.034	0	None
2	Infill	1.75	57	<i>Bacillus pumilus C</i>
2	Blades	0.034	0	None
3	Infill	1.5	53,300	<i>Leifsonia aquatic</i> , <i>Pseudomonas fluorescens</i>
3	Blades	0.031	0	None
<b>Field #2, natural turf</b>				
1	Soil	1.09	4,210,000	<i>Bacillus cereus</i> , <i>Pseudomonas putida</i> , <i>Staphylococcus</i> coagulase negative
1	Blades	0.062	305,000,000	<i>Arthrobacter</i> , <i>Pantoea dispersa</i> , <i>Pseudomonas luteola</i>
2	Soil	1.57	637,000	<i>Enterobacter cloacae</i> , presumptive <i>Bacillus</i> species
2	Blades	0.084	10,500,000	<i>Pantoea agglomerans</i> , <i>Staphylococcus</i> coagulase negative
3	Soil	0.804	1,370,000	<i>Bacillus pumilus C</i> , <i>Staphylococcus lentus</i>
3	Blades	0.08	97,500,000	<i>Chryseobacterium meningosepticum</i> , <i>Staphylococcus aureus</i> , <i>Staphylococcus xylosus</i>

## Bacteria in Artificial Turf: Results and Conclusions

- Fewer bacteria were detected in artificial turf compared to natural turf
- This was true for MRSA and other strains of *Staphylococci*

# Measuring Skin Abrasions

- 2008 intercollegiate soccer season
- 33 Colleges and universities in California and Nevada (athletic trainers)
- Over 500 games reported covering women's and men's teams playing on natural and new generation artificial turf
- Data included abrasions per game, seriousness of abrasion and location on body

Skin abrasion rate ratios for intercollegiate soccer played on the new generation of artificial turf and on natural turf (2008 season).

Groups	Number of teams reporting games on indicated surface	Total games reported	Total skin abrasions reported	Total player hours monitored	Abrasions per 1000 player hours (abrasion rate)	Abrasion rate ratio: artificial/natural (95% CI)
Women artificial turf	22	99	64	1634	39	3.0 (2.0-4.4)
Women natural turf	24	194	42	3201	13	
Men artificial turf	18	59	26	974	27	2.3 (1.4-3.7)
Men natural turf	20	172	35	2838	12	
Women + men artificial turf	40	158	90	2607	35	2.7 (2.0-3.7)
Women + men natural turf	44	366	77	6039	13	

# Skin Abrasions: Results and Conclusions

- Collegiate soccer players suffered approximately 2- to 3-fold more skin abrasions per 1,000 player hours on the new generation of artificial turf compared to natural turf
- Skin abrasion seriousness was similar on the two surfaces

# Study Conclusions

- No public health concerns were identified regarding the inhalation of VOCs or PM2.5 above artificial turf.
- Artificial turf harbored fewer bacteria (including MRSA and other *Staphylococci*) than natural turf.
- The rate of skin abrasions per 1,000 player hours was two- to three-fold higher on artificial turf compared to natural turf.
- The sum of these latter two effects on the ***skin infection rate*** for athletes competing on artificial turf relative to natural turf cannot be predicted from these data alone.